Flight Bags as a Cause of Back Injuries Among Commercial Pilots

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BACKGROUND: Pilots of fixed wing commercial aircraft face numerous occupational hazards. Low back pain is among the most common and costly workplace injury, though relatively little is known about causes of back injuries among pilots. The awkward lifting and twisting maneuvers in the flight deck to position flight bags has not been described as a cause of occupational back injury among pilots.

METHODS: A case series of low back injuries among pilots was identified and described by a retrospective review of charts at an airport-based clinic. Circumstances of occupational back injury, initial direct medical costs, treatment, and work status following evaluation were described.

RESULTS: Over a 6-yr period, 37 occupational low back injuries among 35 pilots were evaluated and treated. Of these, 24 (65%) involved flight bags. Only 27% of pilots with flight bag-associated injuries were returned to work after initial evaluation; medications with sedating properties were frequently required for treatment. Injuries due to slips, trips, and falls, typically in jet bridges or associated with hotel shuttles, were common among pilots with back injuries not related to flight bags.

CONCLUSIONS: The majority of occupational low back injuries seen among pilots in an airport based clinic were attributable to use of flight bags. Substituting electronic flight bags for traditional flight bags could contribute to back injury prevention among pilots.

KEYWORDS: pilot, low back injury, flight bag, occupational hazard, ergonomics.

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More than 1% of workers in the United States sustain an injury that results in at least one day off of work per year.[15] Low back injuries accounted for the largest percentage (41.2%) of musculoskeletal disorders that resulted in at least 1 d away from work in 2012, and were associated with a median of 7 d away from work.[15] A small number of studies suggest that back pain is a significant problem in commercial aviation pilots. While several studies have addressed the incidence or prevalence of low back pain (LBP) in military pilots, particularly pilots of rotary wing aircraft who experience whole-body vibration,[2,4,8] surprisingly little is known about occupational LBP among commercial, fixed wing aircraft pilots. Several cross-sectional studies estimated the prevalence of back pain among pilots. Among commercial pilots of a European carrier, over 50% of pilots reported low back pain that occurred "frequently" or "sometimes" in the preceding 12 mo.[9] Among 174 general aviation pilots in the United Kingdom and Ireland (flight instructors, recreational pilots, charter flight, and small cargo operations pilots) 28.7% reported LBP at least once a week while flying, and 15% experienced LBP with every flight.[13] Among 708 Thai pilots who completed a self-administered questionnaire at the time of their annual medical evaluation, 55.7% reported LBP during the preceding 12 mo.[12]

Few epidemiological studies have evaluated workplace factors that increase the risk of occupational low back injuries among commercial pilots. In the study of Thai pilots, multivariable logistic regression showed that the odds of low back pain occurrence were increased in association with luggage lifting, self-rated noise level in the cockpit, the frequency of

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encountering turbulence, a lack of regular vigorous exercise, and having short rest breaks between flights.[12]

Given that lifting baggage has been identified as a risk factor for low back pain among pilots,[12] it is concerning that pilots had been required to bring flight bags to their flights. Flight bags contained binders of aeronautical charts and flight paths weighing approximately 35–40 lb (16–19 kg).[1,5,10] Pilots had to perform an awkward twisting maneuver while sitting to lift and place the flight bag into a small space beside their seat in the cockpit. At the end of the flight, the process was reversed as they had to bend and twist to lift the flight bag while seated and then stand up. The U.S. Federal Aviation Administration (FAA) first allowed commercial carriers to evaluate replacing the heavy flight bags with lightweight electronic flight bags (EFBs) in 2002. After a transitional period in which the EFBs (specially equipped personal or tablet computers) were used in addition to traditional flight bags, many airlines have recently replaced printed flight path books with EFBs.[1,5,10] Despite the frequency of low back pain among commercial pilots and the poor ergonomics required to maneuver older flight bags, flight bag associated low back injuries among pilots have not been characterized in the medical literature. Thus, the burden of disease that might be prevented by transitioning to electronic flight bags is not known. Flight bag associated injuries have been noted as a cause of injury among pilots treated at the University of Illinois at Chicago acute care and occupational health clinic at O'Hare International Airport. The purpose of this study is to describe occupational low back injuries among commercial airline pilots and to characterize the proportion of such injuries attributed to the older flight bags containing printed flight manuals. Additionally we describe the medical charges and impacts on work status of flight bag associated low back injuries.

METHODS

Subjects

A retrospective case series was reviewed among patients at the University of Illinois at Chicago O'Hare clinic, which is located within the secure side of the airport. The clinic provides urgent care to travelers and airport workers, as well as occupational health services to airport workers, including pilots. Some injured workers are directed to the clinic for evaluation and treatment of occupational injuries by their employers. Pilots are not, but due to convenience, may choose to seek treatment in the clinic. In 2013, the last year for which complete data are available, over 883,000 flights took off from or landed at O'Hare airport.[4] Potential cases were initially identified by ICD-9 codes. Data were abstracted from electronic medical records of pilots who were seen at the clinic from 01/01/2008 to 12/31/2013 with any of the following ICD-9 diagnosis codes: 724.1 (pain in thoracic spine); 724.2 (low back pain); 724.3 (lumbago); 724.4 (sciatica); 725.5 (thoracic or lumbosacral neuritis); 725.5 (backache - unspecified); 847.1 (thoracic sprain); and 847.2 (lumbar sprain). A claim of exemption from human research subject protections review was approved by the Institutional Review Board at the University of Illinois at Chicago.

Procedure and Statistical Analysis

Data elements of interest that were abstracted included the mechanism of injury, job title, pain severity score, treatments, follow-up instructions, and charges. Name, medical record number, employer, date of birth, and other direct identifiers were not abstracted. Summary statistics included means, median, and SDs for continuous variables and frequency distributions for categorical variables.

RESULTS

There were 41 initial presentations for evaluation and treatment identified among 35 pilots. Among these, 37 injuries among 35 pilots were work-related. There were 24 flight-bag associated injuries (among 24 pilots) which accounted for 65% of all work-related injuries, while injuries not associated with flight bags were seen 13 times among 11 pilots.

Demographics of pilots with work-related back injuries are summarized in **Table I**. Of the 37 presentations for work-related back injury, 31 (84%) of the pilots were men and 6 (16%) were women. The age range of pilots with back injuries was 26–58 with a median of 35 yr. Among the 37 presentations, 2 (5%) pilots identified themselves as captain, 14 (38%) identified themselves as first officer, while information about job title was not recorded for the remaining 21 (57%) presentations. The low back was injured in 20 of the 24 (83%) flight bag associated cases; the remaining 4 cases were upper back injuries. Four of the pilots with flight-bag associated injuries had a prior history of low back problems. Demographic characteristics of pilots with back injuries were similar whether or not flight bags were involved in the injuries.

Table I. Characteristics, Treatment, and Work Release Status Among Pilots with Occupational Back Injuries.

	FLIGHT BAG RELATED (*N* = 24)	OTHER WORK-RELATED (*N* = 13)
Mean age, yr (SD)	38.3 (7.3)	33.8 (6.2)
N (percent male)	19 (79%)	12 (92%)
Mean pain score, 1-10 scale (SD)	6.0 (1.8)	4.8 (2.8)
Treatment (categories not mutually exclusive)		
Over the counter medication, *N* (%)	4 (25)	2 (15)
Prescription strength NSAIDs, *N* (%)	21 (88)	8 (62)
Muscle relaxants, *N* (%)	9 (38)	3 (23)
Narcotic analgesics, *N* (%)	5 (21)	1 (8)
Parenteral medication, *N* (%)	5 (21)	1 (8)
Work status		
Released, *N* (%)	4 (17)	5 (38)
Work restrictions, *N* (%)	4 (17)	2 (15)
Unable to work, *N* (%)	15 (67)	6 (46)
Visit charges*, mean (SD)	$448 (161)	$407 (109)

* Excludes medication charges.

The most frequent cause of work-related back injury unrelated to flight bags was a slip or trip and fall in the jet bridge. Six such injuries occurred (46% of nonflight bag injuries) and were attributed to wet floors, irregular walkway surfaces, the aircraft adapter chain, and clothing catching on the interior wall of the jet bridge. Two injuries were related to getting into or out of the hotel shuttle vehicle and two were attributed to twisting while performing a preflight safety check on the flight deck. Other causes of injury mentioned once each were lifting and moving luggage (without mention of the flight bag), opening a tray table while flying home as a passenger ("deadheading"), and pulling on the yoke while landing.

Of the 24 cases of flight bag associated back injuries, 22 (92%) involved twisting, lifting, or twisting with lifting. In some cases, the lifting and twisting was noted specifically to have occurred while seated in the flight deck, but in most cases the record did not specify the circumstances of the injury. In two cases flight bag injuries occurred outside of the aircraft: one occurred as a slip and fall when lifting the bag out of the trunk of a car on the way in to work. The other case was a back strain that occurred after pulling the flight bag along with an overnight bag over a surface that contained road salt and sand. Six pilots reported estimates of flight bag weight ranging from 30 to 40 lb (13.6–18.2 kg), with a median of 37.5 lb (17.0 kg).

Work status was recorded for 23 of 24 pilots (see Table I). The pilot without a documented work status was prescribed a muscle relaxant and was considered in this analysis to be unable to return to work. Ketorolac was administered intramuscularly in five pilots with flight bag associated injuries (21%). Only 4 of 24 (17%) pilots with flight bag associated injuries were considered able to return to work. Four others were returned to work with limitations such as avoiding prolonged sitting or lifting or twisting; for pilots this amounts to being unable to work. Of the 16 who were considered to be unable to work, 10 had been prescribed either narcotic analgesics, muscle relaxants, or both. Two pilots with flight bag injuries were advised to follow up with specialists (neurologist, orthopedist). In both of these cases, the pilots had previously been treated by those specialists. The mean (SD) charges to insurers, excluding medication costs, was $448 ($161) for flight bag associated injuries, comparable to the charges for nonflight bag associated back injuries among pilots.

DISCUSSION

Pilots are a unique worker group in terms of their excellent general health,[14,16] ensured by the medical requirements of the FAA in the United States, and by analogous authorities elsewhere.[6] Among the known occupational hazards of pilots are circadian dysrhythmia, exposure to varying atmospheric pressure, low humidity, noise, vibration, and cosmic radiation.[11] To the best of our knowledge, this is the first study to address injuries attributable to flight bag use among pilots. In this clinic-based study, we observed that the majority of occupational low back injuries were attributed (by the patient/pilot) to flight bags and that these injuries involved lifting and/or twisting movements by the pilots. Injuries typically resulted in temporary disqualification to work. Charges for the initial visit were typically in the $300–$500 range.

Occupational injuries are inherently preventable by substituting less hazardous materials for more hazardous materials, engineering solutions, education, training, other administrative controls, and the use of personal protective equipment. The FAA has determined that EFBs may be substituted for paper flight documents.[7] This appears to be an opportunity to substitute a less hazardous ergonomic exposure (light-weight electronic flight bags) for a more hazardous exposure (the heavier volumes of printed flight manuals). Our work suggests that as many as 65% of occupational low back injuries among pilots could potentially be eliminated by such substitution if it were completely effective. However, this was not an intervention study and the actual impact of EFBs on low back strain injuries among pilots remains to be determined. Unpublished data suggest that such a decrease may have already begun to take place.[1] The mechanism of injury for injuries unrelated to flight bags suggest that ongoing efforts by airlines and airports to reduce slip, trip, and fall injuries among passengers and cabin crews need to be strengthened and may also result in fewer injuries among pilots.

These findings are subject to several limitations. First, we are unable to estimate the incidence rate of low back injuries among pilots. This is due to the fact that pilots with injuries have numerous options for seeking care for occupational injuries, including their primary care physician, specialists (orthopedists, neurologists), and occupational medicine physicians in other clinics. Because pilots are highly mobile, those with injuries at O'Hare may seek care near their primary residence, which could be hundreds or thousands of miles from Chicago. Thus, the numerator data are incomplete and certainly an underestimate of the number of injuries that occur among pilots who pass through O'Hare airport. The degree to which these 37 cases underestimate the actual number of injuries is not known. It is not known to what degree the pilots with occupational back injuries in this case series are representative of such injuries overall. Additionally, denominator data—the number of pilots who pass through O'Hare during clinic operating hours—is unknown, precluding the calculation of an accurate incidence rate.

Other limitations include the absence of pilots with flight bag associated injuries who returned to the clinic for work status re-evaluation. Thus, we do not know how long pilots were unable to work following their injuries. The cost estimates were limited to charges only from the clinic. Taking into account medication, physical therapy, and follow-up visits to primary care providers and specialists would likely result in much higher and more accurate estimates of direct costs. The indirect costs to employers and pilots due to their temporary inability to work would also substantially increase the total costs of flight bag associated back injuries. A full cost accounting of costs and benefits of such a transition should also include consequences of reducing the weight of the flight bag, which has been reported

by several carriers to reduce fuel consumption and costs.[1,5,10] Future studies should focus on injury rates before and after the transition to electronic flight bags. Additionally, initiatives to reduce back injuries among pilots unrelated to flight bags should be pursued. Based on our findings, efforts should focus on slip, trip, and fall injuries in jet bridges, and those associated with shuttle vans between airports and hotel. Such efforts would likely also reduce injuries among passengers and cabin crews.

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